

HW #12

P 18.2 $V_1 = z_{11}I_1 + z_{12}I_2$

$V_1 = z_{21}I_1 + z_{22}I_2$

$z_{11} = \frac{V_1}{I_1} \Big|_{I_2=0} = 5 \parallel 20 + 10 = 20 \Omega$

$z_{21} = \frac{V_2}{I_1} \Big|_{I_2=0} = 16 + (10)(5/25) = 18 \Omega$

$z_{12} = \frac{V_1}{I_2} \Big|_{I_1=0} = 16 + (10/25)(5) = 18 \Omega$

$z_{22} = \frac{V_2}{I_2} \Big|_{I_1=0} = 10 \parallel (5 + 16) = 22 \Omega$

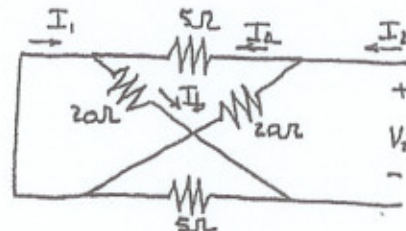
Summary:

$z_{11} = 20 \Omega \quad z_{12} = 18 \Omega \quad z_{21} = 18 \Omega \quad z_{22} = 22 \Omega$

P 18.3 $V_2 = b_{11}V_1 - b_{12}I_1$

$I_2 = b_{21}V_1 - b_{22}I_1$

$b_{12} = \frac{-V_2}{I_1} \Big|_{V_1=0} ; \quad b_{22} = \frac{-I_2}{I_1} \Big|_{V_1=0}$



$5 \parallel 20 = 4 \Omega$

$I_2 = \frac{V_2}{4 + 4} = \frac{V_2}{8} ; \quad I_1 = I_b - I_a$

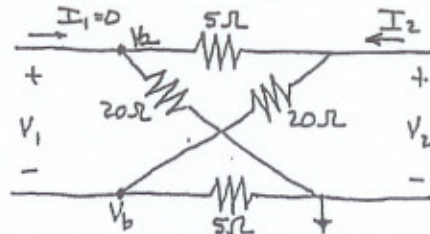
$I_a = \frac{20}{25} I_2 ; \quad I_b = \frac{5}{25} I_2$

$I_1 = \left(\frac{5}{25} - \frac{20}{25} \right) I_2 = \frac{-15}{25} I_2 = \frac{-3}{5} I_2$

$b_{22} = \frac{-I_2}{I_1} = \frac{5}{3}$

$b_{12} = \frac{-V_2}{I_1} = \frac{-V_2}{I_2} \left(\frac{I_2}{I_1} \right) = 8 \left(\frac{5}{3} \right) = \frac{40}{3} \Omega$

$b_{11} = \frac{V_2}{V_1} \Big|_{I_1=0} ; \quad b_{21} = \frac{I_2}{V_1} \Big|_{I_1=0}$



$V_1 = V_a - V_b ; \quad V_a = \frac{20}{25} V_2 ; \quad V_b = \frac{5}{25} V_2$

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Y2

Continue 18.3

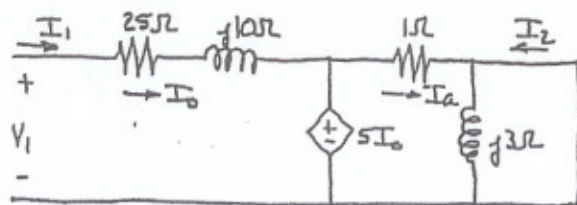
$$V_1 = \frac{20}{25}V_2 - \frac{5}{25}V_2 = \frac{15}{25}V_2 = \frac{3}{5}V_2$$

$$b_{11} = \frac{V_2}{V_1} = \frac{5}{3}$$

$$V_2 = (20 + 5) \parallel (20 + 5) I_2 = 12.5 I_2$$

$$b_{12} = \frac{I_2}{V_1} = \left(\frac{I_2}{V_2}\right) \left(\frac{V_2}{V_1}\right) = \left(\frac{1}{12.5}\right) \left(\frac{5}{3}\right) = \frac{2}{15} \text{ S}$$

P 18.10 $h_{11} = \frac{V_1}{I_1} \Big|_{V_2=0}; \quad h_{21} = \frac{I_2}{I_1} \Big|_{V_2=0}$

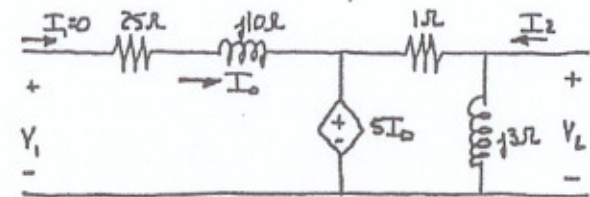


$$I_a = \frac{5I_o}{1} = 5I_1 = -I_2; \quad \therefore h_{21} = -5$$

$$V_1 = (25 + j10)I_o + 5I_o = (30 + j10)I_o = (30 + j10)I_1$$

$$\therefore h_{11} = 30 + j10 \Omega$$

$$h_{12} = \frac{V_1}{V_2} \Big|_{I_1=0}; \quad h_{22} = \frac{I_2}{V_2} \Big|_{I_1=0}$$



$I_o = 0$ thus $5I_o = 0$ cs is a short circuit

$$V_1 = 5I_o = 0; \quad \therefore h_{12} = 0$$

$$h_{22} = \frac{I_2}{V_2} = \frac{1 + j3}{j3} = (1 - j/3) \text{ S}$$

Summary:

$$h_{11} = 30 + j10 \Omega; \quad h_{12} = 0; \quad h_{21} = -5; \quad h_{22} = 1 - j/3 \text{ S}$$

P 18.11 $V_1 = h_{11}I_1 + h_{12}V_2$

$$I_2 = h_{21}I_1 + h_{22}V_2$$

$$I_1 = 0;$$

$$1 \times 10^{-3} = h_{12}(10); \quad \therefore h_{12} = 1 \times 10^{-4}$$

$$200 \times 10^{-6} = h_{22}(10); \quad \therefore h_{22} = 20 \times 10^{-6} \text{ S}$$

$$V_1 = 0;$$

$$80 \times 10^{-6} = h_{21}(-0.5 \times 10^{-6}) + (20 \times 10^{-6})(5); \quad \therefore h_{21} = 40$$

$$0 = h_{11}(-0.5 \times 10^{-6}) + (1 \times 10^{-4})(5); \quad \therefore h_{11} = 1000 \Omega$$

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